Heraeus

Biofuge *fresco*

Instructions for use

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How to use this manual

Use this manual to get acquainted with your centrifuge and its accessories.

The manual helps you to avoid inappropriate handling. Make sure to keep it always close to the centrifuge.

A manual that is not kept handy cannot provide protection against improper handling and thus against damage to persons and objects.

This manual comprises chapters on

- Safety regulations
- Instrument description
- Rotor program and accessories
- Transportation and hook-up
- Use of the centrifuge
- Maintenance and care
- Troubleshooting
- Technical data
- Index

Overleaf you will find a graphic representation of the control panel of the *Biofuge fresco* with a survey of the most important functions

Please fold out

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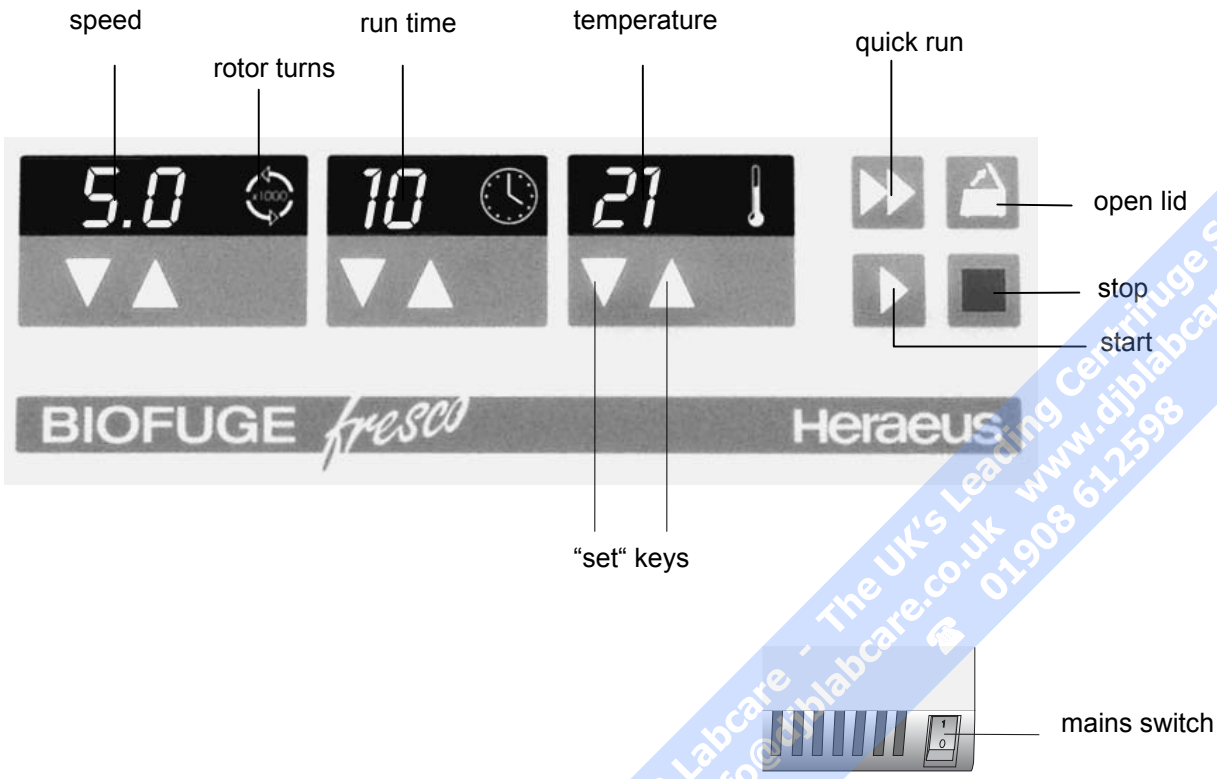

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The control panel of the *Biofuge fresco*

Display

Speed

Resting:	preset speed
Run:	current speed; *rotating light:* rotor turns
End:	"End"
Stop/run:	error codes

Time

Resting/end:	preset run time
During run:	remaining run time or (with quick start) run time passed

Temperature

Resting/end/ run:	current temperature of sample

Keys

Start:	normal start
Quick run:	short-term acceleration as long as key is pressed, with indication of run time passed
Open lid:	open lid (possible only with mains switch ON)
Stop:	manual stop
"Set" keys:	stepwise increase/decrease of preset values, accelerated change when pressed permanently

Short pressing of any of the "set" keys: switch from current to preset value

Error codes
(troubleshooting see chapter "Troubleshooting")

E-00:	motor blockage (transport protection removed?)
E-4:	error in temperature measurement
E-7:	actual temperature out of range
E-8:	excess voltage
E-10:	internal error (call Service)
E-11:	internal error (call Service)
E-23:	deviation in internal temperature calibration
br:	power turned off during run or power failure
Lid:	lid turned loose or opened during run
OPEN:	with lid closed: safety circuit triggered

Warnings can span several display panels

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For your safety

Heraeus centrifuges are manufactured according to current technical standards and regulations. Nonetheless, centrifuges may pose dangers if

- they are not used as designed
- they are operated by untrained personnel
- their design is improperly changed
- the safety instructions are not heeded

Therefore anybody concerned with operation and maintenance of the centrifuge must read and follow the safety instructions.

In addition, the pertinent regulations for prevention of accidents must be strictly followed.

This manual is an integral part of the centrifuge assembly and must be kept close at hand at all times.

Proper use

The centrifuge is designed to separate liquid-suspended materials having different densities and particle size, respectively. The maximum sample density is 1.2 g/cm^3 at maximum speed.

Improper use

During a run, a safety zone of 30 cm around the centrifuge must be maintained where neither persons nor hazardous materials may be stationed.

The centrifuge may cause harm to you or other persons and may damage material goods if you do not respect the following safety measures:

Centrifuging hazardous materials

- The centrifuge is neither made inert, nor is it explosion-proof. Therefore never use the centrifuge in an explosion-prone environment.
- Explosive or flammable substances must not be centrifuged. The same holds for substances prone to react briskly with each other.

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- Do not centrifuge toxic or radioactive substances or pathogenic microorganisms unless you have taken proper precautions.

  Such precautions can e.g. consist of biological seals.
- Should toxins or pathogenic substances enter the centrifuge or its parts, you must carry out the proper procedures for disinfection (see "Maintenance and care – Disinfection").
- Strongly corrosive substances that may cause damage to materials and impair the mechanical strength of the rotor may be centrifuged only inside protective vessels.

Handling

- Never use the centrifuge unless the rotor is properly mounted.
- Never manually open the lid if the rotor still turns.
- Use only original parts for the centrifuge. The only exception are common glass or plastic centrifuge tubes if these are approved for the rotor speed and RCF values of your rotor, respectively.
- Never use the centrifuge with the lid open.
- Never use the centrifuge if the paneling has been partially or totally removed.
- Changes in mechanical or electrical components may be carried out only by persons authorized to this effect by KENDRO Laboratory Products.
- You may use the centrifuge only with a properly loaded rotor. You must not overload the rotor.
- If the rotor or the lid shows visible traces of corrosion or wear, you must stop using it.
- Strictly follow the rules and regulations for cleaning and disinfection.

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Conformity to current standards

Heraeus centrifuges are manufactured and tested according to the following standards and regulations:

CE

for all voltages:

- IEC 1010-1 / EN 61010-1
- IEC 1010-2 / EN 61010-2-020
  - Pollution degree 2
  - Overvoltage category II

for 110 V only:

- CAN/CSA-C22.2 No. 1010.1-92
- CAN/CSA-C22.2 No. 1010.2.020-94

Safety instructions in this manual

This symbol denotes potential hazards to persons.

This symbol denotes potential damage to the centrifuge or parts in its immediate surroundings.

General hints are marked with this symbol.

In addition, you are asked to adhere to the pertinent regulations, in Germany

- Regulations for prevention of accidents BGV A2
- Regulations for prevention of accidents VBG 5
- Regulations for prevention of accidents VBG 7z
- Regulations for prevention of accidents BGV D4

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The *Biofuge fresco*

The figure below shows the *Biofuge fresco* with the lid opened. In this state the standard display is speed x 1,000 and "OPEN".

Safety systems

The *Biofuge fresco* is equipped with a number of safety systems.

Rotor chamber

The rotor chamber consists of a stainless steel case which is sealed against the motor with a rubber cover. When the lid is closed, the rotor chamber is sealed against the surroundings by a rubber ring with a special profile.

The rotor chamber is wrapped in evaporating tubing filled with the ecologically harmless cooling agent R134a, which is free from fluorinated/chlorinated hydrocarbons.

Warning if lid is manually opened during a run, or if drive is overheated

If the lid is manually opened during a run, or if the temperature of the drive exceeds a critical value, a corresponding message appears in the display ("Lid" and "OPEN", respectively).

Lid lock

You can open the lid only when the power is turned on and the rotor has practically come to a halt (< 80 rpm). You can start the centrifuge only if the lid is properly closed.

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Emergency lid release

In order to permit you to remove samples even after a power failure, the centrifuge is equipped with an emergency lid release.

Features

The *Biofuge fresco* is a refrigerated benchtop centrifuge for the preparation of sensitive samples in the biochemical and medical laboratory.

The powerful refrigeration permits, at a room temperature of 25 °C, to maintain a sample temperature of 0 °C over prolonged periods of time even at the maximum speed of 13,000 rpm.

The preset speed is reached in seconds. You can also spin samples for only a few seconds using the "quick run" key (⏩) if this is required for the task in question. The extremely long-lived, maintenance-free induction motor provides quiet and vibration-free operation even at high speeds.

The user-friendly "Easycontrol" control panel permits easy operation. With the centrifuge turned on and the lid closed, the preset speed and run time and the actual temperature are displayed before the run. During operation, the control panel shows the actual values; upon briefly pressing any one of the "set" keys △ or ▽ the preset values for speed, run time and temperature are indicated instead.

After the run, the speed control panel displays "End".

If you press the △ or ▽ keys repeatedly, you increase the corresponding preset value stepwise. If you press and hold down the chosen key, the respective value increases continuously, at first slowly and, after a few seconds, at an accelerated pace.

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Temperature regulation of the *Biofuge fresco*

During a run, the spinning rotor creates frictional heat. This leads to a temperature increase of the rotor, the tubes and finally of the samples. The extent of warming depends on:

- run time
- temperature of the environment
- location of the centrifuge
- rotor speed

The *Biofuge fresco* is equipped with a powerful compression-type refrigeration. Possible settings are from -9 °C to +40 °C. For short-term operation requiring precise temperature control, both the rotor and the rotor chamber must be preadjusted to the desired temperature.

"Quick run" operation

As long as the "quick run" key (⏭) is pressed, the rotor is accelerated with maximum power, potentially up to the maximum speed.

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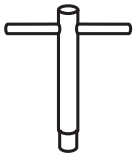
Pieces delivered

The *Biofuge fresco* is delivered complete with:

- a special cap nut for fixing the rotor
- 10-mm tubular socket wrench for fastening the cap nut
- fixed-angle rotor 24 x 1,5 / 2 ml 7500 3328
- cable for mains connection
- this Manual

cap nut
order no.
70056208



tubular socket wrench
order no.
2036 0072

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Accessories

The *Biofuge fresco* is delivered complete with a fixed-angle rotor with 24 holes for placing microliter tubes with a volume of 1.5 or 2.0 ml.

In addition you may order three sets of adapters containing 24 reduction sleeves each. With these adapters you can centrifuge all commercially available microliter tubes with a volume between 0.2 and 0.6 ml as well as 0.2-ml PCR reaction vessels.

A further option is a PCR-Strip rotor.

Please consult our sales documentation for a complete collection of accessories including technical data, order numbers and special low-cost package offers.

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Rotor program

Rotor designation	**Microliter rotor 24 x 2 ml PP**	**PCR-rotor**
order no.	**7500 3328**	**7500 3327**
places / volume	24 x 1,5 / 2 ml	4 x PCR-Strip
maximum permissible load [g]	24 x 4	4 x 4 (32 x 0,5)
maximum speed n_{max} [min^{-1}]	13 000	13 000
minimum speed n_{min} [min^{-1}]	2 000	2 000
maximum RCF value at n_{max}	16 060	12 846 (11 524*)
maximum radius [cm]	8,5	6,8 (6,1*)
minimum radius [cm]	5,9	6,1 (4,7*)
angle [°]	40	45
acceleration / deceleration time [s]	15 / 16	15 / 16
min. temperature at n_{max} [°C] relative to room temperature 25°C	0	0
aerosol-tight	yes (reduced filling)	yes (reduced filling)
permissible temperature range autoclavable (number of cycles)	-4 °C to +40 °C 121°C, (10 cycles)	-4 °C to +40 °C 121°C, (10 cycles)

* The values relate to vessel places 4 and 5 in the PCR-Rotor

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Adapters for rotor order no. 7500 3328

Adapter	Dimensions (∅ x H)	Capacity	Number per Set	Color	Order No.
reduction sleeve PCR	6,2 x 20 mm	0,2 ml	24	gray	7600 3750
reduction sleeve	8 x 43,5 mm	0,5/0,6 ml	24	turquoise	7600 3758
reduction sleeve	6 x 46 mm	0,25/0,4 ml	24	red	7600 3759

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Before use

Where to install the centrifuge

The centrifuge may only be used indoors. Its location must meet the following criteria:

- A safety zone of 30 cm around the centrifuge must be maintained. Hazardous materials must not be kept within this zone during centrifugation.
- The substructure must be stable and resonance-free. A good support is provided by a plane laboratory bench or a large laboratory carriage with casters that may be locked.
- To ensure sufficient air circulation, a minimum distance from the wall of 10 cm at the back and of 15 cm on each side must be kept.
- The centrifuge must be protected from heat and direct sunshine.
- The location should be well ventilated.

Mains connection

Make sure that the mains supply you use for the centrifuge meets the specifications printed on the type plate.

Turn the mains switch off (press "0"); only then connect the centrifuge with the mains supply using the power cord supplied with the instrument.

Removing the transport protection

Turn the instrument on. The display panel shows for about 6 s the routine internal software check sequence. Open the lid by pressing the "open lid" key and remove the transport protection for the rotor.

Check that the rotor moves freely by lightly turning it, and make sure the rotor is tightly screwed on.

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Operation

Transport and installation

Transport the centrifuge only in the upright position using the special box provided with the instrument and secure it properly. Place the centrifuge carefully.

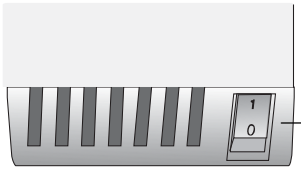
Before using the centrifuge, make sure that the transport protection has been removed!

In order to allow the coolant to settle down in the compressor, the instrument must be left idle at the new location for about ½ to 1 hr.

The *Biofuge fresco* is now ready for use.

Mains connection

Make sure that your mains voltage and frequency match the specifications on the instrument. Turn off the mains switch on the lower right of the instrument (push down the "0" marking), then connect the instrument to the mains supply.



Turn on the mains switch on the lower right (see figure)

mains switch

For a couple of seconds the following reading appears in the control panel:

This tells you that the instrument carries out an internal check of its software.

After a couple of seconds the display changes. The values now shown are (except for the temperature) the ones last used. The temperature reading gives the current temperature of the sample (before the start normally the temperature of the rotor chamber).

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The following figure gives an example of possible readings. A detailed description of possible settings is given below.

In this example, the preset speed is 5,000 rpm, the preset run time is 10 min, and the current temperature reading is 21 °C.

Opening the lid

For normal electrical unlocking, connect the centrifuge to the mains supply, turn the mains switch on and push the "open lid" key ⏏.

Emergency lid release

In case of a power failure you cannot open the lid normally using the "open lid" key (see previous section). To permit unloading even in this case, the centrifuge is equipped with a mechanical lid unlocking system. However, you may use this system **only** in case of emergency.

Rotor can spin at high speed! Touching it may cause severe injuries!

Always wait for several minutes until the rotor has come to a complete stop. Without power the brake does not function, and braking takes much longer than normal!

Should it be necessary to open the lid manually, carry out the following steps:

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1. Unplug the mains plug.

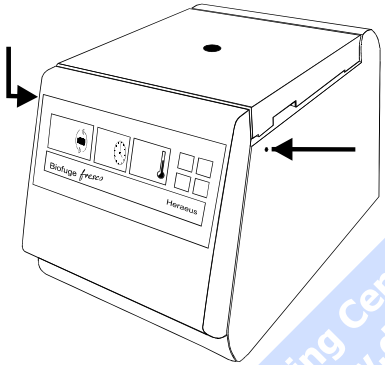
Pull the mains switch before actuating the mechanical emergency lid release!

2. Make sure the rotor stands still.
3. Push a thin screwdriver or another suitable tool horizontally from each side through the two openings in the side panels of the centrifuge (see figure).

   Push the locking pins under the side panels simultaneously from both sides until the lid unlocks audibly. Remove the auxiliary tools and open the lid.
4. In case the rotor still turns, close lid immediately and wait until it has come to a complete stop.

Never brake the rotor using your hands or tools!

5. As soon as the rotor stands still, remove your samples and close the lid.



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Inserting the rotor

Improper or improperly combined accessories may cause severe damage to the centrifuge!

Rotors which are allowed for use in a *Biofuge fresco* centrifuge are detailed in the chapter "Accessories", and only these rotors are to be used in this centrifuge.

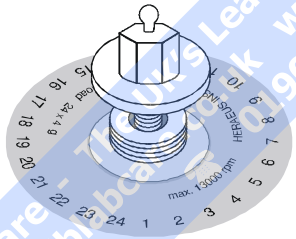
To insert the rotor you will need the cap nut and the socket wrench delivered with the centrifuge (see the chapter “The *Biofuge fresco* – Pieces delivered”).

Possible damage to drive and rotor!

You may insert the rotor only if the temperature of the drive, the rotor and the cap nut is between 10 °C and 30 °C.

Proceed as follows:

1. Open the lid and make sure that the rotor chamber and the rotor are clean. Remove eventual dust, foreign material or sample residues. The thread and the O-Ring on the motor shaft must be in perfect condition.
2. Turn the rotor so that the notch for engaging the drive shaft points downward.
3. Place the rotor on top of the drive shaft so that the notch of the rotor is located precisely above the retaining pin.
4. Push the rotor gently down until the thread is completely laid bare (see figure).



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5. If you have placed the rotor correctly, you can screw on the cap nut easily and secure it with the tubular socket wrench delivered with the instrument.
6. Place the rotor cap onto the rotor.

Do not push the rotor down using force. If you cannot screw on the cap nut, you must carefully lift off the rotor and insert it again.

Regularly check the proper positioning of the rotor and retighten the cap nut as needed.

Permissible rotor temperature

The rotors are only to be used within the temperature range from -4°C to +40°C. Pre-cooling in the freezer is not permitted

Lifetime of the rotor

There is no limitation on the service life of the high performance rotors. However please observe the following due to safety reasons:

Rotors and accessories made of plastic should not be exposed to direct sunlight and UV rays!

If the rotor shows signs of discoloration, deformation or wear, or is out of balance it must be exchanged straight away!

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Removing the rotor

To remove the rotor, you must follow the steps described above in reverse order.

With the hermetic lid, you may in case of contamination separate the rotor from the drive without opening the lid! In this case you can open rotor upon removal from the centrifuge using e.g. a safety work bench before decontaminating it.

Danger of irreparable motor damage!

Never tilt the rotor. Always grab it in the middle and pull out perpendicularly.

1. Open the lid of the centrifuge.
2. Screw the cap nut open by turning it counterclockwise using the socket wrench delivered with the instrument. Remove the cap nut.
3. Grab the rotor in the middle and pull gently upwards off the drive shaft. Be careful not to jam it.

Loading the rotor

Maximum loading

Overloading may cause the rotor to explode! Exploding parts may severely damage the centrifuge!

The *Biofuge fresco* can reach high rotational speeds implying enormous centrifugal force. The rotors are designed in a way warranting sufficient residual strength even at the highest permissible speed.

However, this safety system presupposes that the maximum permissible load of the rotor is not exceeded.

If you wish to centrifuge samples that together with the adapters exceed the maximum permissible load, you must either reduce the sample volume or calculate the permissible speed n_{perm} according to the following formula:

$$n_{perm} = n_{max} * \sqrt{\frac{maximum\ permissible\ load}{actual\ load}}$$

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Filling the centrifuge tubes

Check carefully whether your sample vessels are permissible for the respective *g* value and reduce the speed if necessary.

The smaller the unbalance of the centrifuge, the better the separation since separated zones are no longer perturbed by vibration. It is therefore important to balance the centrifuge tubes as well as possible.

To minimize unbalance you should fill the tubes as evenly as possible. You can achieve this by eye. However, you must nonetheless ensure that opposite tubes are filled to the same level.

Please note that plastic sample vessels only have a limited service life - particularly when used at maximum rpm or temperature - and must be replaced as necessary!

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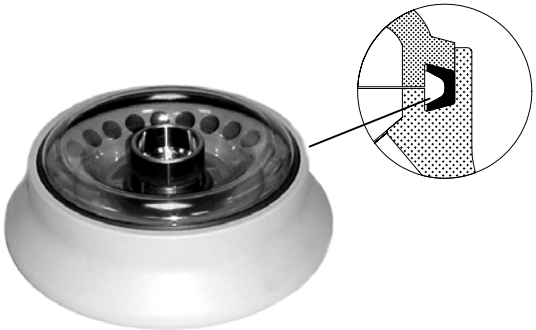
Aerosol-tight application

not with open container lids!

The following steps have to be carried out:

- Lubricate the seals before inserting them (lubricant order no. 75003500)
- Insert the seal (C profile) in the groove at the side of the body of the rotor.
- Insert the O-ring into the inner groove on the screw-on top.



Attention :

Please check that your sample containers are suitable for the centrifugal application desired.

(16060 x g ; temperature in uncooled devices approx. 10 K above room temperature)

Please observe the permissible filling volumes!

Nominal volume:		Permissible volume:
2.0 ml	-	1.5 ml
1.5 ml	-	1.0 ml
others	-	$^{2}/_{3}$ nominal volume

The sealing elements are to be checked regularly for damage to the shape and surface!
Exchange faulty parts immediately.

Spare sealing rings 75003268

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Checking for aerosol tightness

Check the aerosol tightness of your rotor whenever appropriate.

To carry out the test, proceed as follows:

- Carefully clean and degrease the rotor chamber wall, then attach an adhesive white paper strip (about 4 x 2 cm) so that liquid leaking out of the rotor may precipitate on it.
- Fill all places of the respective rotor with water according to the following Table. Insert the rotor into the centrifuge and fasten it.
- Carefully place the amount of test liquid (0.5 % sodium fluorescein in water) specified in the column “leakage test” into the lower part of the rotor within a virtual circle comprising the vessel bores (not the bores themselves) using a pipette or syringe.
- Place the rotor lid on top and screw it on.
  ATTENTION: Make sure that there is no spilled test liquid on the rotor (clean if necessary)!
- Carry out a test run for 10 minutes at maximum rotor speed and 23 °C ambient temperature.
- Check the paper strip under UV light (preferentially in a darkened room):
  If there is no detectable fluorescence, the test is considered passed.
- Finally rinse rotor, rotor lid and lid seal in running water and allow to dry.

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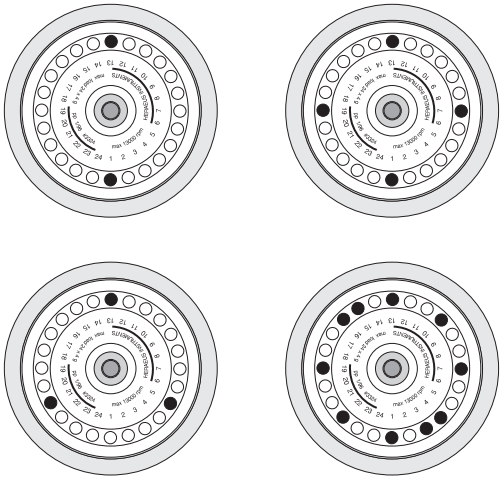
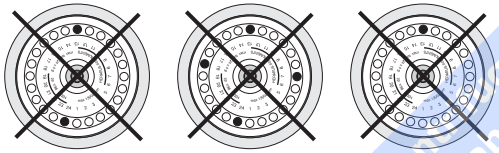
Placing the tubes in the rotor

The rotor must be loaded symmetrically. When loading the rotor only partially, you must ensure that opposite bores always receive tubes of equal weight (when centrifuging a single sample, place a centrifuge tube e.g. filled with water). The following figure gives examples for proper loading.



properly loaded rotors

Improper loading can in the worst case lead to damage to rotor and centrifuge. Unbalance not only causes a noisy run, but rapidly damages the motor suspension.



improperly loaded rotors

When you have loaded the tubes, fasten the rotor lid by screwing the cap nut centrally on it.

Close the lid of the centrifuge by firmly pressing it down. There must be a clicking sound, and the lid must be locked so that it cannot be opened manually.

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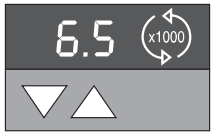
Selecting the speed

The minimum speed of the rotor is 2,000 rpm, the maximum speed 13,000 rpm. The built-in microprocessor prevents higher or lower speed settings. Between these extremes, you can select the speed in steps of 100 rpm using the following procedure:

1. Press one of the "set" keys ▲ (increase) or ▼ (decrease) in the speed control section of the control panel (cf. foldout leaf in the cover):



By pressing the key briefly, you increase or decrease the speed in steps of 100 rpm. This option is supposed to be used for small changes and fine tuning.

2. If you keep the key pressed, the display changes at first slowly and after a few seconds at an accelerated pace.
3. Release the key as soon as you are close to the desired value, and fine tune if necessary by repeatedly pressing the selected key (or its counterpart if you have proceeded too far in one direction). The first digit after the decimal point flashes for a few seconds and then turns permanent. The speed is now stored.

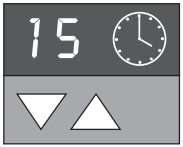
Selecting the run time

You can select a run time between 1 and 99 min or continuous operation.

Preselected run time

To predetermine the run time, proceed as follows:

1. Press one of the "set" keys ▲ (increase) or ▼ (decrease) in the run time section of the control panel (cf. foldout leaf in the cover):



By pressing the key briefly, you increase or decrease the preset run time in steps of 0.1 min. This option is supposed to be used for small changes and fine tuning.

2. If you keep the key pressed, the display changes at first slowly and after a few seconds at an accelerated pace.
3. Release the key as soon as you are close to the desired value, and fine tune if necessary by repeatedly pressing the key (or its counterpart if you have proceeded too far). The display flashes for a few seconds and then turns permanent. The run time is now stored.

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Continuous operation

For continuous operation, press the key ▽ repeatedly or press and hold until "hd" (for "hold") appears in the display.

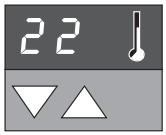
With this setting, the centrifuge keeps running until stopped manually.

Please note that the lifetime of plastic tubes in particular is limited. Extended use may damage them.

Setting the temperature

The temperature is set as follows:

1. Press one of the "set" keys △ (increase) or ▽ (decrease) in the run temperature section of the control panel (cf. foldout leaf in the cover):



By pressing the key briefly, you increase or decrease the temperature in steps of 1 °C. This option is supposed to be used for small changes and fine tuning.

2. If you keep the key pressed, the display changes at first slowly and after a few seconds at an accelerated pace.
3. Release the key as soon as you are close to the desired value, and fine tune if necessary by repeatedly pressing the key (or its counterpart if you have proceeded too far). The display flashes for a few seconds and then turns permanent. The temperature setting is now stored.

The refrigeration starts operating at once if the preselected temperature is below the temperature of the rotor chamber.

Bringing the rotor to the desired temperature in the centrifuge

You can precool or preheat the rotor inside the centrifuge by using the following procedure:

1. Insert the rotor if not already in place. **Attention!** To avoid jamming, do not tilt the rotor! Read the pertinent hints in the chapter "Before use".
2. Adjust the temperature as desired using the keys ▽△ in the temperature control panel as described above.
3. Set the speed to the maximum value.
4. Select a run time of 15 min and start the centrifuge by briefly pressing the start key ▷ .

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If you wish to change the temperature of your samples, please consider that the time required for temperature adjustment is prolonged. The farther apart initial and final temperature, the longer it takes for the temperature to adjust.

The temperature reading does not give the change in the temperature of the sample (the reading is delayed with respect to the actual temperature change). You cannot follow the heating or the cooling of the samples directly. For critical applications you should take other precautions to ensure that the desired temperature is actually reached and maintained (e.g. by measuring the temperature immediately after the run).

Starting the centrifuge

Once the rotor is in place, the main switch turned on and the lid closed, you can start the centrifuge.

Press the "start" key ▷ in the control panel. The centrifuge accelerates to the preselected value. Simultaneously, the run time display starts going backwards from the preset time, giving the remaining run time in minutes. After reaching the last minute the display switches to seconds remaining. The rotating light tells you that the centrifuge is running. During the run, you cannot open the lid.

Changing the settings during the run

You can change the settings while the rotor is spinning (not in the "quick run" mode, see section "Short-time centrifugation" below). The altered value flashes for a few seconds, then changes to continuous display. At the same time the new values are activated.

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Stopping the centrifuge

Stopping with preset time

Normally the run time has been preselected, and all you have to do is wait until the centrifuge terminates the run automatically. As soon as the speed is close to zero, the display reads "End". By pressing the "open lid" key you can now open the lid and remove the samples.

You can also terminate the run at any time as described under "Stopping with continuous operation".

Stopping with continuous operation

If you have chosen continuous operation, you must stop the centrifuge manually by pressing the "stop" key in the control panel. The centrifuge starts braking at once and stops within a few seconds. The speed display changes to "End", and the electrical unlocking mechanism of the lid is available. You can now open the lid by pressing the "open lid" key .

Short-time centrifugation

For short-term operation, the *Biofuge fresco* is equipped with the "quick run" function.

Short-term centrifugation is started by pressing the "quick run" key continuously; it stops as soon as the key is released.

In this mode the centrifuge accelerates with full power up to the maximum speed of 13,000 rpm unless you release the "quick run" key The preset speed is ignored.

The centrifuge accelerates to the maximum speed of 13000 min^{-1}.

Check carefully whether you have to maintain a specific speed for your application.

During acceleration the time is counted forward in seconds. After 60 seconds the display changes to the minute mode.

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RCF value

The **r**elative **c**entrifugal **f**orce (RCF) is usually given in multiples of the earth gravity *g*. It is a dimensionless number that allows one to compare the efficiency of separation or sedimentation of diverse instruments, since it is independent of the instrument used. The only values entered in the equation are radius and speed of centrifugation:

$$RCF = 11.18 * \left(\frac{n}{1000}\right)^2 * r$$

r = radius of centrifugation in cm

n = speed in rpm

At a speed of 13000 min^{-1}, the centrifuge achieves a maximum performance of 16060 *g*!

Check carefully whether your tubes are designed for this centrifugal force, and reduce the speed if necessary.

The figure for the maximum RCF value is based on the maximum radius of the tube.

Please note that this value becomes lower depending on the tubes and adapters used.

You may take this into account when calculating the RCF value for your application.

The figure on the last page of this manual gives a graphic representation of the relation between speed and RCF.

Apart from the maximum RCF value RCF_{max} (lower line) this graph also shows the minimum RCF value RCF_{min}, calculated for the meniscus of the sample (upper line).

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Maintenance and care

Maintenance to be performed by the customer

For the protection of persons, environment and material you are obliged to clean the centrifuge regularly and to disinfect it if necessary.

Unsuitable cleaning agents or disinfection procedures may damage the centrifuge and its accessories!

If you intend to use cleaning agents or disinfection procedures not recommended by the manufacturer, you have to make sure by consulting the manufacturer, that the procedure foreseen does not cause any damages to the instrument!

Cleaning

Pull mains plug before cleaning the instrument!

Clean the casing, the rotor chamber, the rotor and the accessories regularly and in case of need. This is indicated both for reasons of hygiene and to prevent corrosion due to contamination sticking to the instrument and its accessories.

Clean them with mild agents of pH values ranging from 6 to 8.

For other cleaning agents please consult KENDRO!

Immediately after cleaning, dry the aluminum parts or put them into a warm-air dryer at a temperature not exceeding 50°C.

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During cleaning liquids and especially organic solvents should not come into contact with the drive shaft and the ball bearing.

Organic solvents may decompose the lubricant of the motor bearing. The drive shaft may block.

Instruments with refrigeration unit:

If a strong ice sheet is present in the internal chamber, be sure to remove all condensate after defrosting!

Please control and clean the venting slots regularly!

Before cleaning the venting slots please disconnect the centrifuge from the mains supply.

Please pull mains plug!

Disinfection

If a centrifuge tube containing infectious material leaks during a run, you have to disinfect the centrifuge immediately.

Infectious material could enter the centrifuge if spills or tube breakage occur.

Danger of infection may occur upon contact! Take appropriate protective measures for personnel!

Mind the permissible filling volumes and loading limits for the tubes!

In case of contamination the operator has to make sure, that no further persons are jeopardized!

Contaminated parts have to be decontaminated immediately.

If required further protective measures have to be initiated.

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Rotor and rotor chamber must be treated with a neutral, universal disinfectant. Best suited for this purpose are disinfectant sprays, ensuring that all rotor and accessory surfaces are covered evenly.

- Please use 70% ethanol for disinfection.

Please note the safety measures and handling hints when applying these substances!

For other disinfectants please consult KENDRO Services!

- You may disinfect the rotor and the accessories as described in the following section. Be sure to follow the pertinent safety procedures for handling infectious material.

1. Pull mains plug.
2. Unscrew the rotor chuck.
3. Grab the rotor with both hands and pull it perpendicularly off the drive shaft.
4. Remove the centrifuge tubes and adapters, and disinfect them or dispose of them as necessary.
5. Treat the rotor and the rotor lid according to the instructions given for the disinfectant (soaking in liquid or spraying). You must strictly observe the specified action times!
6. Turn the rotor head down and drain off the disinfectant. Thereafter thoroughly rinse rotor and lid with water.
7. Dispose of the disinfectant according to valid regulations.
8. Aluminum rotors have to be treated with anticorrosive protective oil subsequently.

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Disinfection with bleaching lye

These agents contain highly aggressive hypochlorites and must not be used with aluminum rotors!

The following precautionary measures are to be taken for extensive protection of the 7500 3327 and 7500 3328 rotors:

1. Avoid high temperatures!
   The bleaching solution and the rotor should not be warmer than ca. 25 °C.
2. Do not let the bleaching solution act longer than absolutely necessary!
3. After disinfection, rinse the rotor thoroughly with distilled water and allow to dry.

Decontamination

For general radioactive decontamination, use a solution of equal parts of 70% ethanol, 10% SDS and water. Follow this with ethanol rinses, then de-ionized water rinses, and dry with a soft absorbent cloth.

Dispose of all washing solutions in appropriate radioactive waste containers!

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Autoclaving

Check whether autoclaving is permitted!

You may autoclave the rotor and the adapters at 121 °C.

Maximum permissible autoclaving cycle:
20 min at 121 °C.

For safety reasons, the 7500 3327 and 7500 3328 rotors must only be subjected to a maximum of 10 autoclavings!

The rotor must be cleaned and rinsed with distilled water before being autoclaved. Remove the rotor lid, the centrifuge tubes and the adapters. Place plastic rotors on an even surface to avoid deformation.

Chemical additives to the steam are not permitted.

Never exceed the maximum permissible values for autoclaving temperature and autoclaving time.

Should the rotor show signs of wear, you must stop using it!

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The Service of KENDRO

Kendro Laboratory Products recommends annual servicing of the centrifuge and the accessories by the authorized service or skilled personnel. The service provided by KENDRO comprises checking:

- the electrical installation
- the suitability of the location
- the lid lock mechanism and the safety circuit
- the rotor
- the rotor fastening and the drive shaft

Defective parts are exchanged. Besides, the service personnel cleans the rotor chamber.

KENDRO offers inspection and service contracts covering these benefits. Inspection costs are charged as flat-rate contracts.

Necessary repairs are carried out free of cost during the warranty period, and against payment after expiration of the warranty.

Warranty conditions

The warranty period starts with the day of delivery. Within the warranty period the centrifuge is repaired or replaced free of cost if there are demonstrable faults in materials or workmanship.

Conditions for a warranty are that:

- the centrifuge is used according to the instructions of use
- installation, additions, adjustments, changes or repairs are carried out exclusively by personnel authorized for this by KENDRO
- the required maintenance and care procedures are carried out regularly.

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Troubleshooting

Problems you can handle yourself

If problems other than those described in the following tables arise, you must consult your nearest authorized service.

Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
Displays remain dark	The motor stops. The rotor stops without braking. The lid cannot be opened.	**Mains failure or not connected** 1. Is the mains switch turned on? 2. Check the mains connection. 3. If the mains connection is OK, call the nearest Service.
Displays fail briefly	The motor stops suddenly. The rotor stops without braking. The display reads "br", see br.	**Brief interruption of mains supply** 1. Check whether the plug is plugged in properly. 2. Wait for 75 seconds. 3. Restart the centrifuge.
Loud running noise	Centrifuge is exceptionally noisy.	1. Stop the centrifuge by pressing the key , in case of emergency pull mains plug. 2. Wait until the centrifuge stands still. 3. Check whether the rotor is properly loaded. 4. Check whether a broken vessel, damage to the rotor or motor malfunction was responsible for the noise. 5. If you cannot locate and solve the problem, call Service.

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Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
Lid cannot be opened	Pressing the "open lid" key has no effect.	**A) Lid not correctly engaged or lid warped.** 1. Check whether the mains supply is OK and the instrument is switched on (displays lit). 2. Press the lid down in the middle of the front section and actuate the "open lid" key once again. 3. In case these measures have not the desired effect, you may open the lid with the emergency lid release. (see page 18). **B) Heat monitoring relays in the lid unlocking magnets have been actuated.** Press the key again after waiting for about 1 min.
br	Instrument was switched off during run, or brief mains failure.	If the instrument was switched off inadvertently, switch on again. Wait for about 75 seconds. The centrifuge comes to a stop without braking.
E-00	Motor does not start.	**Motor or rotor is blocked.** 1. Switch the instrument off and on again using the mains switch. 2. Open the lid. 3. Remove transport protection from the rotor.

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Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
E-4	Error in temperature measurement	1. Switch the instrument off and on again. 2. If the error persists, call Service.
E-7	Actual temperature outside tolerance (<-10 °C or >50 °C)	Switch the instrument off and on again. Should the display "E-7" persist, the temperature control circuit is defective. Please call your nearest Service.
E-8	Overvoltage or over-current at the U/F converter	Mains voltage outside tolerance. Brake resistance defective. Switch the instrument off and on again. If the problem persists, call Service.
E-10	Wrong check sum in the NV-RAM	Switch the instrument off and on again. If the problem persists, call Service.
E-11	Error in data transfer from NV-RAM	Switch the instrument off and on again. If the problem persists, call Service.
E-23	Deviation in the internal temperature adjustment	Switch the instrument off and on again. If the problem persists, call Service.

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Error	Behavior of the centrifuge	Possible cause(s) and measures to be taken
"Lid" appears in the display	Motor stops. Rotor comes to a stop without braking.	**The lid was manually opened during the run.** 1. Press the lid shut. The instrument comes to a stop without braking. 2. If you want to continue the centrifugation, you must switch the instrument off and on again. The message "br" is displayed and the centrifuge brakes (see br). **The safety circuit has been actuated.** 1. Pull the mains plug. 2. Control ventilation slots and clean if necessary. 3. After 20 min you can start the instrument again. 4. If the safety circuit is again actuated, call Service.
Display "OPEN" appears although lid is closed	Start impossible	**The safety circuit has been actuated.** 1. Pull the mains plug. 2. Control ventilation slots and clean if necessary. 3. After 20 min you can start the instrument again. 4. If the safety circuit is again actuated, call Service.

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In case you must call the Service

Should you require our Service, please tell us the order no. and serial number of the instrument. You find the pertinent information at the back of the instrument near the socket for the mains plug.

Moreover it is helpful for our service technician (and saves you expenses) to know the valid software version. You can determine the software version as follows:

1. Switch the instrument off.
2. Switch the instrument on.

   The display reads *888 88 88* for a couple of seconds.

   Subsequently, the display may read e.g. *0978 06* (processor 0978 version 06) for about 2 seconds.

   For approximately another 2 seconds, the display may read e.g. *415 8 03* (NV-RAM 4158 version 03).

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Technical data

Component parts and performance

Part / function	Description
Design	**Armored case:** stainless steel **Frame**: torsion resistant, hot galvanized steel plates **Body and front panel**: impact-resistant, highly dampening plastic **Lid**: stove-enameled steel plate with integral high-resistance foam insulation
Keys and display panel	Keys and display panel covered with easy care protective foil
Control elements	User-friendly "Easycontrol" system
Rotor chamber	Material: stainless steel Dimensions (diameter x height): 180 mm x 54 mm
Lid release	Electromagnetic release with key when switched on.
Lid lock	Automatic locking when the lid is pressed down
Emergency lid release	Lid release in case of mains failure: emergency release with straight pins

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Function / parameter	Value
environmental conditions	- indoor use - max. elevation 2000 m above sea level - max. relative humidity 80 % up to 31 °C; linearly decreasing down to 50 % relative humidity at 40 °C.
permissible temperature of the environment	10 °C to 35 °C during operation (no condensation) -10 °C to 50 °C for storage and shipping
maximum speed n_{max}	13,000 min^{-1}
minimum speed n_{min}	2,000 min^{-1}
maximum RCF value at n_{max}	16,060
maximum kinetic energy	1.65 kNm
set temperature range	-9 °C to +40 °C
noise at maximum speed	< 55 dB (A); <45 dB (A) with standstill refrigeration
dimensions (H x W x D)	305 mm x 290 mm x 450 mm
weight without rotor	27 kg

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The "Easycontrol" user interface

Function	Performance
Start	Start key (▷)
Stop	Stop key (■)
Quick starting and stopping	"Quick run" key (▷▷): short-time run when pressed permanently; stop when released
Indication of operating state	Spinning rotor indicated by rotating lights (LED) in the speed display panel
End of centrifugation	Speed display reads "End"
Digital parameter display	• speed • run time • temperature
Speed selection	adjustable in steps of 100 min^{-1} in the range 2000 min^{-1} to 13,000 min^{-1}
Run time selection	adjustable in minutes between 1 min and 99 min; "hd" mode: continuous operation
Temperature selection	adjustable in steps of 1 K between -9 °C and 40 °C

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Function	Performance
Time display in "quick run" mode	between 1 s and 60 s in seconds, above 60 s in minutes
Parameter memory	• for speed • for run time • for temperature
Diagnostics	• lid not properly closed: display "OPEN" • general faults in performance (error codes)
Testing standards 230V instruments Manufactured and tested in accordance with 120 / 100V instruments Manufactured and tested in accordance with	 EN 61 010-1, EN 61 010-2-020 EN 61326 (+ EN 61000-3-2/A14:2000-6) EN 55011 B IEC 61010-1:1990 + amendment 1:1992 + amendment 2:1995 IEC 61010-2-020:1993 + amendment 1:1996 CAN/CSA-C22.2 No. 1010-1.92 CAN/CSA-C22.2 No. 1010-1.B97 amendment 2

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Electrical connections/fuses

Order no.	Voltage	Frequency	max. current	Power consumption	Fuses inside instrument *
7500 5521	230 V	50/60 Hz	1.7 A	270 W	2 x 4 A slow-blow (5 x 20 mm)
7500 5522	120 V	60 Hz	3.8 A	270 W	1 x 6.25 A slow-blow (6.3 x 32 mm)

* The fuse may be replaced only by authorized servicing personnel!

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Autoclaving protocol				
1	Date	Remark	Operator	Signature
2				
3				
4				
5				
6				
7				
8				
9				
10				

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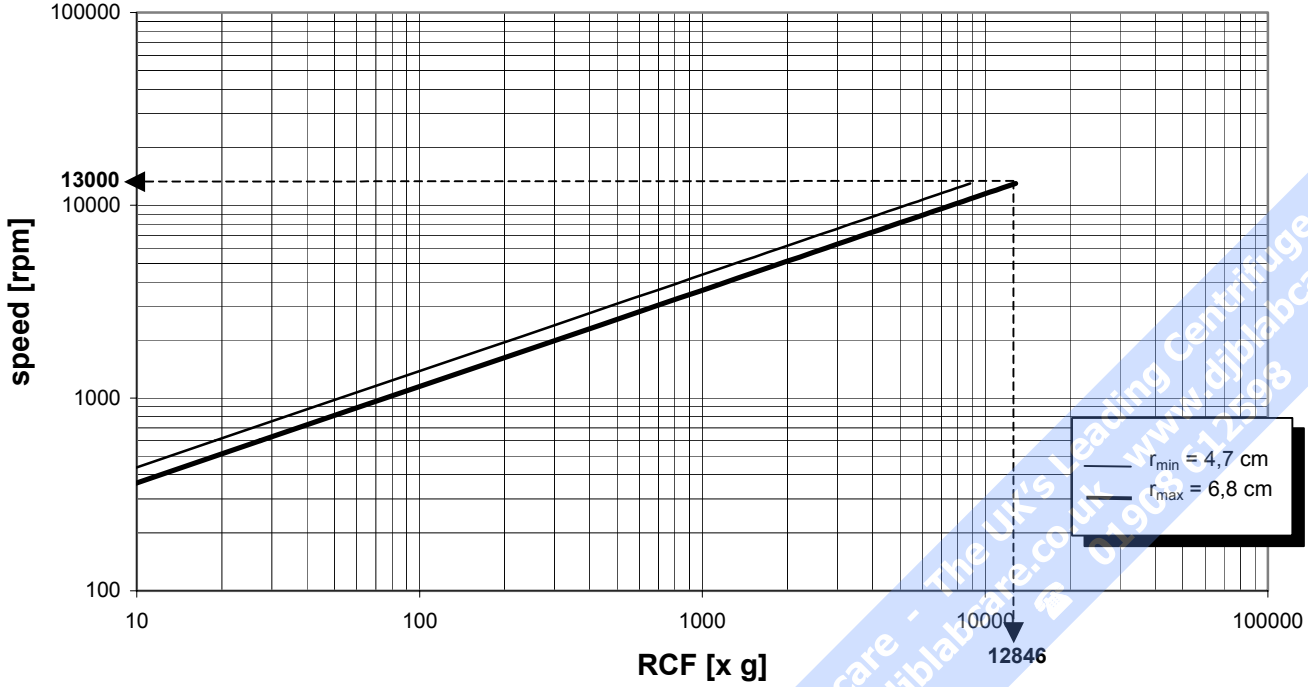
Speed / RCF diagrams for PCR-Rotor 7500 3327



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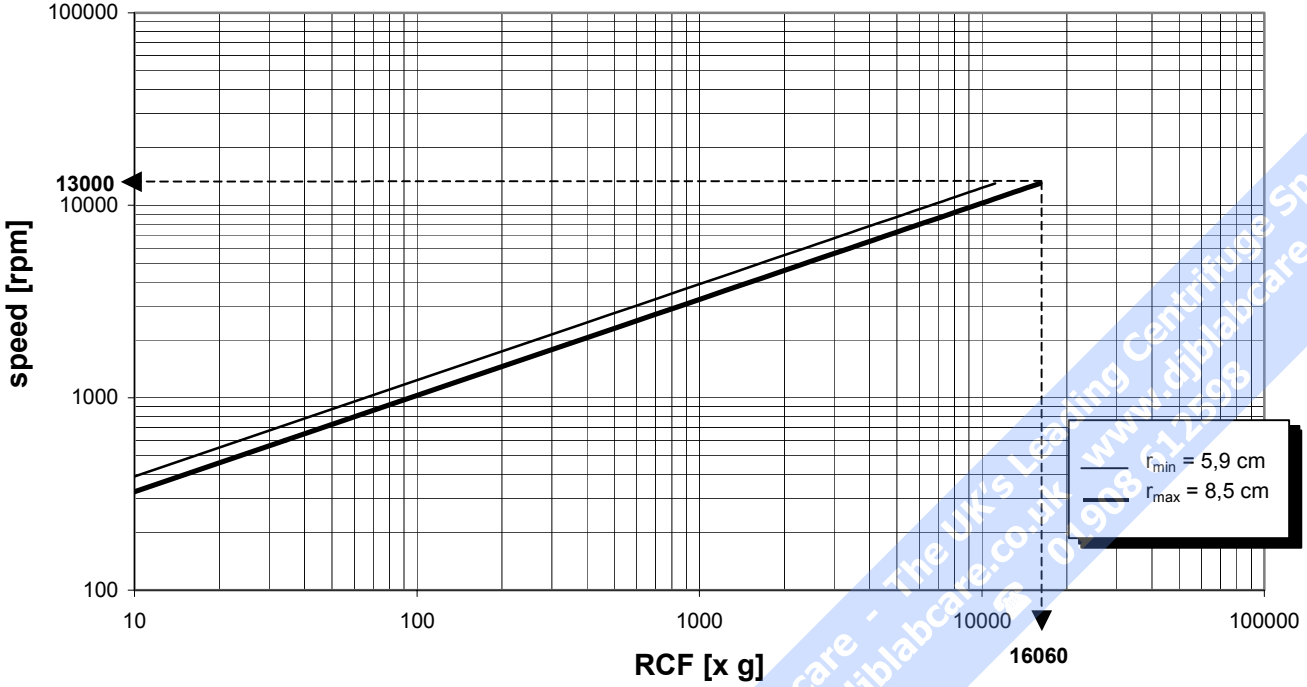
Speed / RCF diagrams for 24 x 2ml Rotor 7500 3328



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